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these collections are as useful as books, which no one thinks of cutting up and distributing in his herbarium.

WILLIAM TRELEASE.

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Prof. Beal, in the April number of the GAZETTE, desires the experience of others in the arrangement of the herbarium. My practice is about parallel to his. In the college herbarium in my charge, the arrangement is by Bentham & Hooker for orders and genera. In my private herbarium, kept at my house, and hence subject to incessant consultation, I arrange my orders as above, but where the order is a large one, place the genera in alphabetical sequence. While this is much the most convenient way for ready reference, I know that in my own case I lose by it something of familiarity with the generic affinities. With a too faulty memory one is apt to acquire an alphabetical rather than an actual notion of the relations of things.

W. WHITMAN BAILEY.

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Adopting the suggestion made by Prof. Beal (April GAZETTE, p. 98) that the experience of others in herbarium arrangement would be of interest, I note the methods found most expedient in the herbarium at the National Museum.

The genera are all arranged in the cases according to the *Genera Plantarum* of Bentham and Hooker. Pasteboard "flaps," labeled with the contents of each compartment, serve to direct the search for any particular genus, and this is all that is required, for one working constantly about an herbarium soon learns where, approximately, everything is. But the species are all arranged alphabetically, and it is found to be of the greatest convenience. Originally some of the larger genera were arranged systematically, after some monographer (the oaks and Junci after Engelmänn, the willows after Bebb, etc.), but this was found to be cumbersome in the extreme, and was abandoned. In a large herbarium like this, where a genus is often represented by from fifty to two hundred species, no method as satisfactory as the alphabetical has been proposed.

F. H. KNOWLTON.

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CURRENT LITERATURE.

Tendrils Movements in Cucurbita maxima and C. Pepo. By D. P. Penhallow, Am. Jour. Sci., Jan., Feb. and Mar., 1886.

Under this title Prof. D. P. Penhallow gives the results of more than 400 complete observations upon the tendrils in motion. During the process of the development of the tendril, a variety of movements are noted and remain to be accounted for. These are: (1) torsion, which, contrary to Sachs, is easily shown to exist in tendrils of Cucurbitaceæ, (2) circumnutation, (3) effects of irritation, (4) spasmodic movements at end of activity, (5) coiling about a support, and (6) free coiling. Believing that all these motions are but varied phenomena of plant growth, dependent upon the same conditions, experiments with the vine, the terminal bud, and the fruit were entered upon, that the conditions governing growth in general might be made the basis of tendril investigation; and for the peculiar manifestations in the tendril, reference was made to its histological structure and the accepted theory of the continuity of protoplasm.

The squash tendril is composed of the following tissues: the central pith, which gradually breaks down at maturity; a ring of wood bounded by one of parenchyma, beyond which lies the most important region, that of the collen-

chyma tissue, extending to the epidermis—its continuity broken at three well-defined points by large-celled parenchyma.

These three parenchyma regions can be recognized on the surface of the tendril, as dark green bands extending through its length on the upper side and on the right and left. Among these the greatest growth occurs in turn without regular order, and here the activity longest remains. The name vibrogen is applied to these bands, as designating their importance in the circumnutation and coiling of the tendril.

Unequal growth in the wood, the collenchyma and the vibrogen produces unequal tension in these tissues, hence resulting movements of the whole body. It has been demonstrated by Sachs and Darwin that a band of rapidly growing cells traveling around the circumference of an organ is sufficient to account for the phenomenon of circumnutation, but a study of the irregular figure described by the squash tendril shows that recourse must be had to the vibrogen for explanation of the movement here, particularly as it appears from investigation that the horizontal movements are twice as great as the vertical ones, a fact depending upon the peculiar distribution of the three vibrogen bands.

Torsion is produced by the rapid growth of the vibrogen bands not followed by a corresponding growth elsewhere.

Irritation upon the surface of the tendril, particularly in the region of the collenchyma least broken by the parenchyma, *i. e.*, the lower surface, causes cessation of growth and condensation of structure, hence a bending toward the irritating surface. The same is true when coiling results from contact with a support.

When mechanical irritation is applied at any part the impulse is conveyed from cell to cell through the continuity of protoplasm which is best demonstrated in the collenchyma tissue.

The other movements enumerated are also explained upon similar grounds, and the manifestation of these movements in tendrils alone is accounted for by the localization of the vibrogen bands, the disproportion between length and diameter, the great flexibility of the organ and the greater effect of unequal tension when exerted longitudinally through a filamentous structure.

GRACE E. COOLEY.

Handbook of Plant Dissection. By J. C. Arthur, C. R. Barnes, and J. M. Coulter. Henry Holt & Co., New York. 1886. 12°. pp. 256. 2 plates.

The aim of this volume has been to provide for instructors and students a detailed account of a series of representative types illustrating the different groups of the vegetable kingdom from the lowest to the highest. As the title implies, it is not a general treatise to which the student is to go for information, but a practical handbook to be used in the laboratory while examining common plants, such as can be obtained anywhere at the proper season. In general the plan is that of Huxley and Martin's *Elementary Biology*, but the species selected for study are different. The *Thallophytes* are represented by five, the *Archegoniata* by three, and the *Phænogams* by four species. The student is supposed to begin with *Protococcus viridis*, a plant more easily obtained in quantity than *P. fluviatilis*, and better adapted than the yeast plant for showing the typical structure of the vegetable cell. Each chapter starts with a short account of the general appearance and mode of collecting the plant to be examined. There then follow minute directions for studying the gross and minute anatomy, and at the end of the chapter the student's attention is drawn to the relation of what he has seen to the structure of the vegetable cell and the phenomena of plant growth and reproduction in general. In an introductory chapter is a short account of the apparatus and reagents needed in the laboratory.

There is a great need of a book like the present, for the number of persons who wish to study botany by what we may call the type-plan is already large and increasing. In a work of this kind the temptation is to include too much

and make a small encyclopædia rather than a working handbook. The authors have happily escaped this difficulty and given us a book of convenient form with all the necessary information condensed in a small space. There is a great but unwise demand for plates in books of this sort, but, not to mention the necessarily high cost of a book with numerous good plates, it seems to us better that a laboratory handbook should not contain plates, but, if plates are required, they can better be provided in the form of charts or atlases.

The selection of plants to be studied is a good one and large enough to occupy the student's time for several months at least. We would suggest, however, that it might have been well to add some common lichen like *Physcia stellaris*, for the biological relations of the lichens are important and likely to interest the student. The proportions of the book are to be commended, for, although a greater number of species of Thallophytes are presented, the space devoted to that group is less than half as great as that devoted to Archegoniata and less than a third of that assigned to Phanogams. By the arrangement adopted, the student starts by observing a few things, and as he advances and becomes more proficient he can work more exhaustively.

If it is necessary to train the observing powers of students, as is almost always the case at the present time, there is, of course, a danger that a handbook like the present may be abused and that the student may rely too closely on the directions given. In the preface, the authors call attention to the possibility of such an abuse and make the important suggestion that, if a teacher finds that his class are following the handbook blindly and not using their own eyes, he should substitute other species nearly related botanically to those given in the book. The directions for work would apply as before, but the student would have to work out details for himself.

W. G. FARLOW.

Vorlesungen über Bacterien. Von A. de Bary. Leipzig: Wilhelm Engelmann, 1885. pp. 146. 18 woodcuts. 8°.

It is within a year that the author published a brief treatise upon bacteria as part of his *Morphologie und Biologie der Pilze Mycetozoen und Bacterien*. The present work follows to some extent the same line of treatment, but of course is more complete, touching upon many themes not permissible within the compass of the previous work. It is also, for the most part, in a more simple and flowing style, which comes from the matter having first been given in a series of lectures.

The author does not attempt to provide a treatise devoted to particularities regarding all cases of interest and importance, a "bacteriology," but to afford a general survey of the subject which may enable one to find his way intelligently among the multiplicity of details. As one can not properly see the city for the houses, or the forest because of the trees, unless a commanding position be obtained, so it is in the mazes of this new science. This is the great service which the author has done, to point out in a masterly way the true relation of the facts to one another, and to bring the whole into harmony with the other departments of biology.

The following is an outline of the contents of the book. The use of the words bacteria and fungi is discussed. The structure of the bacterian cell, the forms of cells and of cell-families, and their development are successively treated. When the author points out how simply the different forms of the single cells of bacteria may be illustrated, he more deeply enlists the interest of the student who is at the same time an instructor. He says: One may separate them into round-celled forms and two rod-forms, straight and spiral. A billiard ball, a pencil and a corkscrew represent these three forms with much accuracy, so that expensive illustrative models are not needed.

The whole work has been presented with much perspicuity; it has also been divested of that remoteness and strangeness with which we are wont to regard the subject. This has been done by tracing many analogies with familiar facts pertaining to higher vegetation. In speaking of the necessity

of taking into account the modes of grouping in order to be able to distinguish between such minute objects, he says that "in the phenomena of grouping there appear specific characters which must, indeed, be present in the single cells, but with the means at our command can not be recognized or only with difficulty, yet, as it were, become cumulative in larger masses. This is, however, nothing peculiar. Of cells, which in comparison with bacteria are enormously large and richly organized, we can not say with certainty, when they are presented singly, whether they belong to a lily or to a tulip plant. In their natural combination or grouping, however, the one always goes to build up the tulip only, and the other the lily, and herein we know that they are different."

Probably one of the most interesting parts of the book to the general reader is the fourth chapter, which deals with the *pro* and *con* of the existence of species among bacteria, and their affinities and position in the system. There are some kinds of plants, the author says, in which there is a constant recurrence of the same forms with relatively small individual variation. Most of the common higher plants and animals are examples of these, as well as many low, simple kinds. With some practice one can name them from single pieces dissociated from their developmental connection. A horse chestnut may, *e. g.*, be determined from a single detached leaf. Other kinds of plants are pleomorphic, subject to many changes of form, partly from external and partly from internal causes. In contrast to the horse chestnut the white mulberry produces very dissimilar leaves, some simply cordate, others lobed and cut. One would not be able to determine the species from the last, if he had previously only seen the cordate form. Among lower plants pleomorphism is not confined to bacteria, but is common among the algæ and fungi. The pleomorphic species differ from the relatively simple forms, therefore, only in their more varied development; the characteristics of species do not the less occur in them than in the others. There was no question regarding true species among bacteria for 150 years after their discovery; the controversy was introduced by Cohn when he published his memorable classification of growth forms.

So we might continue to give the author's views regarding these form-species, the errors which have arisen by inattention to details of manipulation in performing cultures, even by such noted investigators as Nägeli and Buchner, and the systematic affinities and peculiarities of the bacteria. These and many other topics will prove of great interest to the biologist.

The fifth chapter considers the occurrence and distribution of bacteria, followed by processes of growth, relations to the substratum, parasites and saprophytes, important examples of the latter described, the phenomena of parasitism, harmless parasitic kinds in warm-blooded animals, relation of bacteria to infectious diseases of animals and plants, which takes us to the end of the fourteenth chapter. A bibliography of important works and a name register closes the volume.

The importance of a work like this is not easily overestimated. It may not bring out many new facts, but it places those which are already known in their true light, and makes clear the real position of the science.

The Methods of Bacteriological Investigation. By Dr. Ferdinand Hueppe. Translated by Hermann M. Biggs, M. D. New York: Appleton & Co., 1886. 8°. pp. 218. 31 woodcuts.

Die Methoden der Bakterien-Forschung. Von Dr. Ferdinand Hueppe. 3d ed. Wiesbaden: C. W. Kreidel, 1886. 8°. pp. 244. 2 colored plates and 40 woodcuts.

This work by Dr. Hueppe was written at the request of Dr. Koch, the most renowned of bacteriologists, whose name imparts a guarantee of value to the book. It does not, however, stand in special need of a sponsor, for the most casual examination shows it to be superior to any work upon technological

methods yet issued. The subject is presented in a careful, well-balanced, well-digested form, not encumbered with unnecessary diffuseness and not marred by too great attention to pathological and omission of non-pathological details. Investigations in bacteriology, in order to carry weight, must be conducted with a full appreciation of the absolute need of refined manipulation, and their completeness depends upon a knowledge of the numerous ways in which they may be conducted and of the ends to be attained by each process. This work admirably meets the requirements of a safe and practical guide to both the student and the specialist.

Some of the topics treated are the principles of sterilization, direct examination of bacteria, uses and methods of staining, pure cultures, cultivation in fluids, fractional and dilution methods, opaque and transparent solid cultures, slide, plate and test-tube cultures, determination of the causal relation of bacteria to decomposition and disease, septic and parasitic bacteria, the effects of temperature, pressure, gases, and electricity upon bacteria, how to study the bacteria in earth, air and water. Many other topics are also considered, but an enumeration of all of them would still fail to give a just idea of the book's real value, which lies to a considerable extent in the admirable manner in which each topic is treated.

Some fault might be found with the translation, but as the defects do not affect the truthfulness of the work, so far as noticed, they may well be left to the captious. The American publishers have done their part of the work well, although the matter has been spread over one-fourth more space than in the German edition. The two fine colored plates are omitted, but a useful index is added.

The German work was published in February, 1885. It ran through two editions, and in November, 1885, a third much improved and augmented edition was prepared, but was not received in time for the translator to make use of it. This third edition adds seventy pages of new matter and nine new woodcuts. The additions are scattered throughout the work, upon nearly every page, the most considerable being descriptions of Fol's sterilizing kettle, Chamberland's porcelain filter, apparatus for sterilizing and cultivating at constant temperatures below 75° C., other forms of culture vessels and inoculating instruments, additional nutrient solutions, and the principles of staining. The four pages of the original work upon the classification of the bacteria have been nearly tripled and entirely rewritten. The colored plates illustrate slide, plate and test-tube cultures, cultures on opaque solid media, and staining for several purposes.

Bacteriological studies in America can not fail to receive a decided impulse from the advent of this admirable work, and we shall not be surprised to find that new editions are demanded often enough to keep pace with the growth of technic.

NOTES AND NEWS.

THE *Western Druggist*, published in Chicago, has a good botanical department, edited by Prof. E. S. Bastin.

AN INTERESTING article on Pezizæ by J. B. Ellis is given in the April number of the *Journal of Mycology*.

DR. GOODALE is giving a course of semi-weekly lectures before the Woman's Education Association of Boston.

IN THE JUST established Buffalo College of Pharmacy, Dr. D. S. Kellicott has been appointed professor of botany and microscopy.

A WORK on the forms of bacteria and their relation to genera and species has been published by Dr. Hueppe, and is reviewed in this number.